DEVELOPING COST PREDICTION MODEL FOR BUILDING PROJECT

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Abstract - *The critical problem in the construction industry is that building projects are completed at cost much higher than estimated project cost, hence it is essential to develop a cost prediction model that imprison all factors contributing to the project cost using multiple regression analysis through set of objectives such as: to locate the factors affecting the project cost; analyze the significance of the factors and develop cost predictive model. Literature review on the study designated that nature of clients, professional involved in a project and their resolution regarding design, function, duration, technology and execution have significant effect on the overall project cost. The study points out the seven most exceptional factors to project cost among the design related variables as: design related factors, time or cost related factors, parties experience related factors, financial issues related factors, bidding situations related factors , project characteristics related factors and estimating process related factors. These selected key factors are to be used for cost predictive model. The cost prediction model can be developed with the help of SPSS software, the factors governing the project cost are determined with the help of questionnaire survey. Seven major factors have been selected for the cost prediction modeling.*

Key Words: **Multiple regression analysis, cost prediction model, SPSS**

1. INTRODUCTION

A successful project means that the project has been completed within budgetary costs and within the available schedule. But it is found out that in construction work always the project completion cost is much higher than the estimated project cost. This have not only led to the loss in project but also delays the project. And also the client is concerned with quality, cost and time and wants the building to be constructed at a reasonable cost and within a specified period of time. For these reasons, the contractors should exercise great care and skill in the design of the project with constant checks on cost. Therefore integrated efforts of the various parties and their resolutions regarding the design, technology and execution of the project can have significant effect on the overall project cost. Therefore it is important to examine the wide discrepancies between planned and actual construction cost due to lack of effective prediction cost models.

The major part of a construction project is its financial demands. Therefore a better examination and study of construction project, all cost – associated variables have to be analyzed prior to the analysis of the final cost. Construction project duration is one of the important variables in construction project cost. However, precise studies of construction projects are difficult to do since there have been many factors varying from one project to another such as: project size type, location, season of the year, material type, structure, and method of construction. Therefore, in this study an attempt is to be performed to predict the future cost of construction project.

The main objectives of this study are:

[1]Identifying factors affecting the accuracy of cost estimation of building project, and
[2]To examine the importance of the identified factors based on significance of their contribution.

2. LITERATURE REVIEW

Afshin Firouzi et.al., (2016)   Construction projects are typically carried out in highly uncertain environments with the risk of cost and time overruns, and subsequent disputes between stakeholders. One of common risk factors is that most cost items of a project are dependent random variables. Thus, correlations between basic cost items need to be considered in predicting the total cost of the project. This paper intends to propose a generic copula-based Monte Carlo simulation method for prediction of construction projects" total costs with dependent cost items. An algorithm to generate the joint probability distribution function of correlated cost items is developed and two examples are presented to demonstrate the applicability of copulas in modeling construction costs as random variables.

Chang Yoon Ji et.al., (2015)   For any construction project to succeed, it is very important to accurately estimate the construction cost during the project's initial stage. This is why there has been much interest lately in cost prediction models that use case-based reasoning CBR. It has been pointed out, however, that existing CBR-based cost prediction models may yield inaccurate results even though they could survey optimal similar cases, if the number of cases in the case base is not enough. As opposed to the existing CBR-based construction cost prediction models, this study developed a CBR revision model that reflects the "revise" phase of the CBR cycle retrieve, reuse, revise, and retain_ based on nine multifamily housing projects executed recently by "A" Housing Corporation. To verify the developed model, a case study was performed using three case projects completed by "B" and "C" Housing Corporations. The result showed that the prediction error ratio after the Revise phase decreased from 97.44 to 22.58%. This model can be effective when there are insufficient established cases in the case base.

Dikko H.A (2002) Housing and infrastructure development represent an important aspect of capital development that Governments all over must pay attention to as part of their social responsibilities. Developed and developing countries are constantly engaged in activities aimed at maintaining, improving or adding new stock to their housing and infrastructure amongst others in order to help overall developmental goals. As stated earlier, development in this area is continuous over many, many years. It follows that in any country or location there exist a wealth of information on previously executed projects. The objective of this paper is to highlight in general terms the services that could be offered by the Quantity Surveyor or Cost Engineer in organizing the available information into a data bank and use it as a basis to plan for future projects, including cost control activities at the implementation stage. We will also highlight the fact cost control models are more critical to developing countries, largely because of the unstable nature of their economies. This in turn led to the failure of many projects.

Hany Shoukry Tawfek et.al., (2012) Many definitions for quality were provided by experts. Among these definitions are: quality is the fitness for use, conformance to requirements, quality is a predictable degree of uniformity and dependability, at low cost and suited to the market. Cost of quality is an essential element of the total cost of any construction project. Consequently, the accurate assessment of such cost of quality can materially affect the reliability of the estimated cost of any construction project. Stated differently, the accurate and reliable cost estimating for any construction projects is not really possible without the deep investigation for the expected cost of quality of this project. Cost of quality is generally affected by many factors. Any attempt to assess the cost of quality of any project should take the different cost of quality factors into consideration. The main objective of this paper is to establish a neural network model that will enable the construction firms to assess cost of quality for any future building project.

Huawang Shi et.al., (2014) Construction cost estimation and prediction, the basis of cost budgeting and cost management, is crucial for construction firms to survive and grow in the industry. The objective of this paper is to present a novel method integrating rough sets (RS) theory and an artificial neural network (ANN) to forecast construction project cost. Because there are many factors affecting the cost of building and some of the factors are related and redundant, rough sets theory is applied to find relevant factors to the cost, which are used as inputs of an artificial neural-network to predict the cost of construction project. Therefore, the main characteristic attributes were withdraw, the complexity of neural network system and the computing time was reduced, as well. A case study was carried out on the cost estimate of a sample project using the model.

Khaled Hesham Hyari et.al., (2015) Cost estimation for public projects includes, but is not limited to, construction costs and engineering services costs. The available cost estimation models for these projects focus on the construction phase, with little or no consideration given to engineering services. This paper presents an artificial neural network model for the conceptual cost estimation of engineering services for public construction projects that considers both design costs and construction supervision costs. In developing the model, the authors first identify the factors that influence the cost of engineering services, and then apply a suitable artificial neural network for a cost estimation model. The model predicts the cost of engineering services as a percentage of construction cost based on project type, engineering services category, project location, and project scope.

Krzysztof Zima et.al., (2016) The paper presents calculation of a unit price of construction elements or works with the use of the case-based reasoning (CBR) method. The primary source of knowledge in the CBR method is a collection of cases encountered in previous problems and retained in memory. The solution to a completely new problem is generated by finding the most suitable cases and adjusting them to the new case. A method of a unit price calculation will be shown which uses the prices found in the accessible set of previously occurring cases, i.e. it uses the prices listed in estimations presented in offer bids. The CBR systems consist of data bases in which the cases are stored along with their solutions. So the paper presents a concept of a knowledge base supporting the process of cost estimation at the preliminary stage of a construction.

Li Liu et.al., (2010) Central to cost-based competition is the capability to accurately predict the cost of delivering a project. Most literature on cost estimation focuses on specific estimation methods as generic techniques and little attention has been paid to the unique requirements at each project stage. This note attempts to identify the critical factors for effective estimation at various stages of typical construction projects. Drawing from organization control theory and cost estimating literature, this note develops a theoretical framework that identifies the critical factors for effective cost estimation during each project phase of a conventional construction project.

Lowe D.J. et.al., (2006) This paper describes the development of linear regression models to predict the construction cost of buildings, based on 286 sets of data collected in the United Kingdom. The same data have been used to develop neural network model and purpose of developing the regression models was to provide a benchmark against which the neural networks could be compared. Raw cost is rejected as a suitable dependent variable and models are developed for three alternatives – cost/m2, log of cost and log of cost/m2. Both forward and backward stepwise regression analyses were performed to produce a total of six models.

Muhammad T. Hatamleh et.al., (2018) Cost estimating process is an important element within the project life cycle. Comprehensive information, expanded knowledge, considerable expertise, and continuous improvement are needed to obtain accurate cost estimation. The purpose of

this paper is to identify the critical factors that affect accuracy of cost estimation and evaluate the degree to which these factors are important from contractors' and consultants' viewpoints. Qualitative and quantitative research approaches were adopted in collecting and analyzing the data, and testing the hypotheses. Based on the literature review, a questionnaire was prepared and then was modified according to the results of face-to-face open-ended interviews conducted with 11 project managers. The final version of the questionnaire was distributed to a random sample of 265 respondents. The analysis revealed that there is a strong agreement between contractors and consultants in the ranking of the factors related to consultant, contractor, design parameters, and information. A slightly weak agreement between contractors and consultants was noted regarding the factors related to market conditions and factors related to project characteristics. Furthermore, the results show that the top ten factors affecting the accuracy of cost estimate are clear and detail drawings and specification, pricing experience of construction projects, perception of estimation importance, equipment project complexity, clear scope definition, accuracy and reliability of cost information, site constraints material availability, financial capabilities of the client, and availability of database of bids on similar project.

Nicharat Kuljaroenwirat et.al., (2016) Cost overrun is the important issue in the construction industry that gets attention in several countries. This study focuses on affected construction company to examine the cost overrun factors of a public construction project, such as dredge and road. The prediction model for cost overrun in pretender phase was developed base on artificial neural networks (ANN), case-based reasoning (CBR), and hybrid ANN-CBR by using actual information collected from the construction contract and experts interviewing. The evaluation result during model development process shows that ANN was more accurate than CBR. On the other hand, the result of each model validated with 12 unseen projects shown that ANN and CBR with factor weights averaged from the best ANN model also have acceptable accuracy. However, CBR is more useful to support constructors" decision, since CBR itself could produce results with similarity score included as the probability percentage.

Seokjin Choi et.al., (2013) Long-term transportation policies require government officials to predict the costs of public road construction during the conceptual planning phase. However, early cost prediction is often inaccurate because public officials are not familiar with cost engineering practices, and moreover, have limited time and insufficient information for estimating the possible range of the cost distribution. This study develops a conceptual cost prediction model by combining rough set theory, case-based reasoning, and genetic algorithms to better predict costs in the conceptual planning phase. Rough set theory and qualitative in-depth interviews are integrated to select the proper input attributes for the cost prediction model. Case-based reasoning is then applied to predict road construction costs by considering users" difficulties in the conceptual

policy planning phase. A genetic algorithm is also used to assist the rough set model and case-based reasoning model to obtain optimal solutions.

Sherif M. Hafez et.al., (2015) The increased interest in using Building Information Modeling (BIM) in detailed construction cost estimates calls for methodologies to evaluate the effectiveness of BIM-Assisted Detailed Estimating (BADE) tools in generating detailed construction cost estimates. The focus of this research is on developing a quantified evaluation method to measure the impact of these BADE tools. Further, in order to understand the cognitive details of the estimator, this research also tested and evaluated the impact of the visualization factor and the compound impact of the visualization factor and aggregated calculation factor on the construction cost estimating process. Two cases study were tested, building and bridge. Three methods were applied on each case study, method 1the manual estimating method, method 2 used a BADE tool without a calculation function (i.e., the quantities of the individual building components can be read as properties of the component), method 3 used a BADE tool with calculation functions that allowed the user to directly calculate/aggregate the query results of the BIM database in the MS Excel spreadsheet. Results obtained from the test cases helped to reinforce the reliability of the observations and the evaluation. Four parameters were used to evaluate the performance results individually in the first step: generality, flexibility, efficiency, and accuracy. Then a multi-attribute utility model, which took into account the four individual parameters, was developed and used to evaluate the overall performance of BIM assisted estimating versus the performance of the traditional estimating method on quantity takeoffs. The research concluded that the BIM-assisted estimate demonstrated better performance over traditional estimating methods. Both the visualization and aggregation functions of the BADE tool had significant impact on the performance of the detailed estimate.

Yu Wenhui et.al., (2015) Considering the shortcomings of conventional cost prediction methods, neural network was adopted to establish the cost prediction model of equipment system, which could efficiently solve the problems on the determination of network structure. And due to the importance of parameters optimization in Neural Network model, rough set was used to optimize the model parameters. The experiment results show that method can quickly obtain the optimal parameters satisfying the precision requirement with a simple calculation, which solves the problem of complex calculation and empiricism in conventional methods. The evaluation on the testing cases shows the neural network model with rough set has a good generalization performance and can be popularized in cost prediction. At last, the experiment on an independent testing case shows the model optimized by neural network combined with rough set has a better prediction performance.

Yu-Ren Wang et.al., (2011) The construction projects have become larger in scale and more complex in system

engineering in the past few decades. The researchers and industry practitioners have recognized its potential impact to final project outcomes and started to put more emphasis on early planning process. Nevertheless, the early planning practice varies significantly throughout the industry. This research intends to benchmark the early planning practice for the building construction industry in Taiwan and develop ANN-ensemble classification models to predict project success using survey data.

3. CONCLUSION

Different aspects of various authors on cost estimation and cost prediction models were discussed and analyzed. Based on these information gathered from literature search, eighty factors were identified and used for the study. Other studies on the research designated that nature of clients and the professionals involved on a project and their collective resolution regarding the design, function, duration, technology and execution of the project have significant effect on the overall project cost The study have point out the seven most exceptional factors among the design related variables as : Design related factors, Time or Cost related factors, Parties experience related, Financial issues, Bidding situations, Project Characteristics, Estimating Process. These amounts to seven key factors and all these factors are to be used for the cost prediction model. The major conclusion is that cost overrun in building construction is still a critical problem due to various reasons. Therefore, there is an urgent need for developing an advanced cost predictive model in building construction that should yield better result.

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